
Hydrologic Conditions in the Delaware River Basin



NASA GOES-12 satellite captured this view of the coastal low, formerly known as Ida, on November 12 at 3:01 p.m. ET, drenching the Mid-Atlantic. Credit: NASA GOES Project

Annual Report 2009



Prepared by Operations Section, Water Resources Management Branch, Delaware River Basin Commission
June 2010

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Hydrologic Highlights of 2009

Remnants of Tropical Storm Ida

The Delaware River Basin was not affected by drought or main stem flooding during 2009. The hurricane season was less active than in prior years and only one of nine named storms impacted the Delaware River Basin (DRB). Tropical Storm Ida came ashore at Dauphin Island, Alabama on November 10 and eventually transformed into a powerful Nor'easter that impacted coastal communities in Delaware and New Jersey on November 12-14. Sustained winds of 40-60 mph pummeled portions of these states and caused moderate tidal flooding and severe beach erosion.

Precipitation

Precipitation during 2009 was above normal for the majority of the counties¹ within the DRB. Only five of the 38 reported counties, all located in the northern tier of the basin, registered below-normal precipitation for the year. These deficits were modest, ranging from 2.1% to 4%. Overall, annual precipitation departures-from-normal ranged from 1.90 inches (4%) below normal in Monroe Co., Pennsylvania to 19.10 inches (44%) above normal in Atlantic Co., New Jersey.

Annual precipitation totals ranged from 37.60 inches in Broome Co., New York to 62.60 inches in Atlantic Co., New Jersey. The observed precipitation above Montague, New Jersey for 2009 was 45.46 inches, or 2.20 inches above normal. Similarly, observed precipitation above Trenton, New Jersey was 45.93 inches, or 1.04 inches above normal, and precipitation at Wilmington, Delaware was 51.40 inches, or 8.59 inches above normal. [Figure 1 presents the annual precipitation by county in the DRB](#) and [Table 1 presents normal and observed monthly precipitation totals at select stations in the DRB for 2009](#).

Streamflow

Observed monthly mean streamflows at select stations on the Lehigh River, Schuylkill River, and the main stem Delaware River were generally normal to below normal during the first five months of the year due to periods of below-normal precipitation. The driest periods were February and March when observed streamflows at select stations on the Lehigh and Schuylkill rivers were as much as 60-70% below normal. Normal to above-normal precipitation returned to the basin in May and streamflows at select stations recovered. Normal to above-normal streamflow conditions persisted for the remainder of the year. [Table 2 presents observed monthly mean streamflows at select stations for 2009](#) and Figures 2 and 3 present hydrographs at [Montague](#) and [Trenton](#).

Lower Basin Reservoir Storage

Both Beltzville Reservoir (located on the Pohopoco Creek, a tributary of the Lehigh River) and Blue Marsh Reservoir (located on the Tulpehocken Creek, a tributary of the Schuylkill River) maintained storage in the normal range during 2009. Consequently, DRBC's lower basin drought operating plan was not triggered. Due to the above-normal precipitation during 2009, DRBC did not have to direct releases from lower basin storage to meet the Delaware River flow objective of 3,000 cubic feet per second (cfs) at Trenton. Figures 4 and 5 present reservoir elevations for 2009 for [Beltzville](#) and [Blue Marsh](#), respectively.

¹ This information is based on precipitation data from the National Weather Service Middle Atlantic River Forecast Center for 38 of the 42 counties located either partially or completely in the DRB. Data for the remaining four counties are not available. Departures from normal are calculated by DRBC staff.

No releases were required from Merrill Creek Reservoir during 2009. Storage in Merrill Creek Reservoir, located near Phillipsburg, New Jersey, replaces consumptive use caused by power generation and provides flow augmentation when the basin is under DRBC-declared drought operations.

Upper Basin Reservoir Storage

Storage within the three New York City (NYC) reservoirs, located in the upper DRB and operated under the **Flexible Flow Management Program (FFMP)**², remained above the long-term median for much of 2009. Consequently, DRBC's basinwide drought operating plan was not triggered.

On January 1, 2009, combined storage in Cannonsville, Pepacton, and Neversink reservoirs was 270.8 billion gallons (bg), which is 100% usable capacity and 81.3 bg above the long-term median usable storage for the date. Combined storage in the three reservoirs dipped below the median usable storage during the period April 18 - May 18, but refilled to 100% usable storage capacity by May 20. The normal refill date for the NYC reservoirs is May 1. Storage remained above the median for the remainder of the year. On December 31, 2009, combined reservoir storage was 246.1 bg, which is 91% usable capacity and 57.3 bg above the long-term median usable storage for the date. [Figure 6 presents NYC Delaware reservoir storage levels for 2009.](#)

The Office of the Delaware River Master directed releases from the NYC reservoirs during 2009 to meet the normal flow target of 1,750 cfs at Montague. Releases totaling approximately nine billion gallons were directed from the NYC reservoirs during dry periods in September and October. For comparison, directed releases totaled 47 bg in 2008 and 101 bg during the drought year 2001.

In the fall of 2009, the FFMP was adjusted to include a Temporary Supplemental Release Program (TSRP). The TSRP, developed in response to work that was needed on the Rondout West Branch Tunnel, allowed for additional water to be released from the NYC reservoirs than was normally authorized under the FFMP. The extra releases under the TSRP were planned to relieve the NYC reservoirs of the storage that could not be diverted to Rondout during the time the Rondout West Branch Tunnel was shut down for repairs. The TSRP, implemented by NYC DEP, was in effect from September 1, 2009 through May 31, 2010.

Groundwater

The average monthly groundwater level in eight reported U.S. Geological Survey (USGS) observation wells in the Pennsylvania portion of the basin remained below the long-term average through July 2009. In response to above-normal rainfall during the June through August period, the average water level of the observation wells increased above the long-term average beginning in August and remained above the long-term average until the end of the year.

Water levels in the New Castle Co., Delaware coastal plain well began the year at the low-end of the normal range³ and by March had trended downward to below the normal range. Levels recovered to within the normal range by June and trended upward for the remainder of the year. The year ended with above-normal levels.

Water in the Cumberland Co., New Jersey coastal plain well began the year within the normal range, but by February dropped to below-normal levels. Water levels recovered to the normal range by August, trending

² Beginning in October 2007, the NYC reservoirs were operated in accordance with the FFMP, a temporary operations plan unanimously approved by the parties to the 1954 U.S. Supreme Court Decree (four basin states and NYC).

³ Water level ranges are defined as: Above Normal (> 75-percentile); Normal (25- to 75- percentile); Below Normal (< 25-percentile).

upward to finish the year above the normal range. Mid-year upward trends in both coastal plain wells can be attributed to the above-normal rainfall received during the summer months. Figures 7, 8, and 9 provide graphical presentations of groundwater levels throughout the year for the [eight USGS network wells in Pennsylvania](#), the [Delaware Geological Survey \(DGS\) well in New Castle Co., Delaware](#), and the [USGS well in Cumberland Co., New Jersey](#), respectively.

Salt Front

The *salt front* is defined as the 250 parts-per-million (ppm) isochlor. The seven-day average location of the salt front is used by DRBC as an indicator of salinity intrusion in the Delaware Estuary. The salt front's location fluctuates along the main stem Delaware River as streamflow increases or decreases in response to changing inflows, diluting or concentrating chlorides in the river. Long-term average mid-month locations range from river mile 61 in mid-April (0.5 miles below Pea Patch Island, Delaware) to river mile 81 in mid-October (Marcus Hook, Pennsylvania). The farthest recorded upstream location of the salt front, river mile 102, was measured during the 1960's drought of record.

During 2009, the salt front location ranged as far upstream as river mile 75 (February 2009), a location that is three miles downstream of the Delaware-Pennsylvania state line. [Figure 10 presents the seven-day average location of the 250-ppm isochlor.](#)